



Preparing the Site

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Temperature Requirements

The switch requires an operating temperature of 32 to 104 degrees Fahrenheit (0 to 40 degrees Celsius). If the switch is not operating, the temperature must be between –40 to 158 degrees Fahrenheit (–40 to 70 degrees Celsius).

Humidity Requirements

Buildings in which the climate is controlled by air-conditioning in the warmer months and by heat during the colder months usually maintain an acceptable level of humidity for the switch equipment. However, if the switch is located in an unusually humid location, use a dehumidifier to maintain the humidity within an acceptable range.

Altitude Requirements

Altitude rating is 10,000 ft (3048 m). For China, it is 6,562 ft (2000 m).

Dust and Particulate Requirements

Exhaust fans cool power supplies and system fans cool switches by drawing in air and exhausting air out through various openings in the chassis. However, fans also ingest dust and other particles, causing contaminant buildup in the switch and increased internal chassis temperature. Dust and particles can act as insulators and interfere with the mechanical components in the switch. A clean operating environment can greatly reduce the negative effects of dust and other particles.

In addition to keeping your environment free of dust and particles, follow these precautions to avoid contamination of your switch:

- Do not permit smoking near the switch.
- Do not permit food or drink near the switch.

Minimizing Electromagnetic and Radio Frequency Interference

Electromagnetic interference (EMI) and radio frequency interference (RFI) from the switch can adversely affect other devices, such as radio and television (TV) receivers. Radio frequencies that emanate from the switch can also interfere with cordless and low-power telephones. Conversely, RFI from high-power telephones can cause spurious characters to appear on the switch monitor.

RFI is defined as any EMI with a frequency above 10 kHz. This type of interference can travel from the switch to other devices through the power cable and power source or through the air as transmitted radio waves. The Federal Communications Commission (FCC) publishes specific regulations to limit the amount of EMI and RFI that are emitted by computing equipment. Each switch meets these FCC regulations.

To reduce the possibility of EMI and RFI, follow these guidelines:

- Cover all open expansion slots with a blank filler plate.
- Always use shielded cables with metal connector shells for attaching peripherals to the switch.

When wires are run for any significant distance in an electromagnetic field, interference can occur to the signals on the wires with the following implications:

- Bad wiring can result in radio interference emanating from the plant wiring.
- Strong EMI, especially when it is caused by lightning or radio transmitters, can destroy the signal drivers and receivers in the chassis and even create an electrical hazard by conducting power surges through lines into equipment.



Note To predict and prevent strong EMI, you need to consult experts in radio frequency interference (RFI).

The wiring is unlikely to emit radio interference if you use a twisted-pair cable with a good distribution of grounding conductors. If you exceed the recommended distances, use a high-quality twisted-pair cable with one ground conductor for each data signal when applicable.

**Caution**

If the wires exceed the recommended distances, or if wires pass between buildings, give special consideration to the effect of a lightning strike in your vicinity. The electromagnetic pulse that is caused by lightning or other high-energy phenomena can easily couple enough energy into unshielded conductors to destroy electronic switches. You will want to consult experts in electrical surge suppression and shielding if you had similar problems in the past.

Shock and Vibration Requirements

The switch has been shock- and vibration-tested for operating ranges, handling, and earthquake standards.

Grounding Requirements

The switch is sensitive to variations in voltage that is supplied by the power sources. Overvoltage, undervoltage, and transients (or spikes) can erase data from memory or cause components to fail. To protect against these types of problems, ensure that there is an earth-ground connection for the switch. You can connect the grounding pad on the switch either directly to the earth-ground connection or to a fully bonded and grounded rack.

When chassis is properly installed in a grounded rack, the switch is grounded because it has a metal-to-metal (no paint, stain, dirt, or anything else on it) connection to the rack. Alternatively, you can ground the chassis by using a customer-supplied grounding cable that meets your local and national installation requirements. For U.S. installations, we recommend 6-AWG wire. Connect your grounding cable to the chassis with a grounding lug (provided in the switch accessory kit) and to the facility ground.

**Note**

You automatically ground AC power supplies when you connect them to AC power sources. For DC power supplies, you must connect a grounding wire when wiring the power supply to the DC power source.

**Note**

An electrical conducting path shall exist between the product chassis and the metal surface of the enclosure or rack in which it is mounted or to a grounding conductor. Electrical continuity shall be provided by using thread-forming type mounting screws that remove any paint or non-conductive coatings and establish a metal-to-metal contact. Any paint or other non-conductive coatings shall be removed on the surfaces between the mounting hardware and the enclosure or rack. The surfaces shall be cleaned and an antioxidant applied before installation.

Planning for Power Requirements

The switch includes two power supplies (1-to-1 redundancy with current sharing) in one of the following combinations:

- Two 1500-W AC power supplies
- Two 1100-W DC power supplies



Note For 1+1 redundancy, you must use two power sources and connect each power supply to a separate power source.



Note Some of the power supply modules have rating capabilities that exceed the switch requirements. When calculating your power requirements, use the switch requirements to determine the amount of power that is required for the power supplies.

To minimize the possibility of circuit failure, make sure that each power-source circuit that is used by the switch is dedicated to the switch.



Warning **Statement 1033**—Safety Extra-Low Voltage (SELV)—IEC 60950/ES1—IEC 62368 DC Power Supply
To reduce the risk of electric shock, connect the unit to a DC power source that complies with the SELV requirements in IEC 60950-based safety standards or ES1 and PS1 requirements in IEC 62368-based safety standards or to a Class 2 power supply.



Note We recommend 8-AWG wire for DC installations in the U.S.

Planning for Power Requirements

To plan for the power requirements of a switch, you must determine each of the following:

- Power requirements for all the switch components
- Minimum number of power supplies required to power the components that are installed in the switch.
- Power mode to use and the number of extra power supplies required for that mode.

Ensure that the circuit that is used for the switch is dedicated to the switch to minimize the possibility of circuit failure.

Calculate the power that is required for operations (available power) and redundancy (reserve power), then you can plan for the required number of input power receptacles. The power receptacles will be within reach of the switch location.

Step 1 Determine the power requirement for the modules in the switch by summing the maximum wattage for each installed module, see the following table.

Component	Typical	Maximum
Supervisor modules	—	—
– Supervisor A (N9K-SUP-A)	69 W	80 W

Component	Typical	Maximum
– Supervisor A+ (N9K-SUP-A+)	69 W	80 W
– Supervisor B (N9K-SUP-B)	75 W	90 W
– Supervisor B+ (N9K-SUP-B+)	75 W	80 W
System Controller Modules	—	—
– System Controller (N9K-SC-A)	14 W	25 W
Line cards that are supported by N9K-C9508-FM fabric modules	176 W	251 W
– 36-port 40-Gigabit Ethernet QSFP+ line cards (N9K-X9736PX)	197 W	211 W
Line cards that are supported by N9K-C9508-FM-E fabric modules	455 W	570 W
– 32-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9732C-EX)	430 W	720 W
– 36-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9736C-FX)	607 W	900 W
– 36-port 40-Gigabit Ethernet QSFP28 line card (N9K-X9736Q-FX)	571 W	684 W
Line cards that are supported by N9K-C9508-FM-E2 fabric modules	266 W	420 W
– 32-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9732C-EX)	430 W	720 W
– 36-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9736C-FX)	607 W	900 W
– 36-port 40-Gigabit Ethernet QSFP28 line card (N9K-X9736Q-FX)	571 W	684 W
Line cards that are supported by N9K-C9508-FM-G fabric module	500 W	936 W
– 36-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9736C-FX)	607 W	900 W
– 36-port 100-Gigabit Ethernet QSFP28 line card (N9K-X9736Q-FX)	571 W	684 W
– 16-port 400-Gigabit Ethernet QSFP-DD line card (N9K-X9716D-GX)	650 W	1680 W
Fan Trays		
– (N9K-C9508-FAN)	176 W	250 W
– (N9K-C9508-FAN2)	79 W	900 W
Blank Fan Power Card		
– (N9K-C9508-FAN-PWR)	45 W	90 W

The system software reserves, by default, the maximum power required to power-on two Supervisors, two System Controllers, and three fan trays (generation 1). The total required power budget for the chassis to boot would then be the sum of the maximum power of all the fabric modules, fan trays, and line cards installed on the chassis. Here are two examples:

Component	Quantity	Max. Power	Total Power
N9K-SUP-B+	2	80 W	160 W
N9K-SC-A	2	25 W	50 W
N9K-C9508-FM-E2	5	420 W	2,100 W
N9K-C9508-FAN	3	250 W	750 W
N9K-X9736C-FX	4	900 W	3,600 W
Total System Power			6,660 W

Component	Quantity	Max. Power	Total Power
N9K-SUP-B+	2	80 W	160 W
N9K-SC-A	2	25 W	50 W
N9K-C9508-FM-G	4	936 W	3,744 W
N9K-C9508-FAN2	3	900 W	2,700 W
N9K-C9508-FAN-PWR	2	90 W	180 W
N9K-X9716D-GX	4	1,680 W	6,720 W
Total System Power			13,554 W

Step 2 Determine the number of power supplies required to power the modules that are installed in the switch by dividing the module power requirement amount (see Step 1) by the output wattage (3000 W) of the power supplies installed in the switch. Round up the fractional result to the nearest ones digit.

For example, if you are installing a switch with maximum consumption of 4154 W, you need two power supplies ($4154 \text{ W} / 3000 \text{ W} = 1.38$ [rounded up to two power supplies]) to operate the switch and its modules.

Step 3 Determine the amount of power that is required from a power source.

The power supplies are rated to have at least 91-percent efficiency.

- To determine the input power (Watts) from the power source to the power supplies, divide the output power of each power supply (3000 W) by the efficiency of the power supply (0.91) and then multiply the result by the number of power supplies required to power the switch. For example, if the switch uses 2 power supplies, you can calculate the amount of power that is required from the power source as follows:

$$3000 \text{ W output} / 0.91 \text{ efficiency} \times 2 \text{ power supplies} = 6593 \text{ W}$$

- To determine the number of Amps (A) that are required to power the switch, divide the maximum Watts that is required for by the voltage that is used as shown in the following examples:
 - For 6593 A at 200-volts AC (VAC), use the following formula:
 $(6593 \text{ W}) / (200 \text{ VAC}) = 33 \text{ A}$
 - For 6593 A at 277-volts AC (VAC), use the following formula:

$$(6593 \text{ W}) / (277 \text{ VAC}) = 23.8 \text{ A}$$

- For 6593 A at 380-volts DC (VDC), use the following formula:

$$(6593 \text{ W}) / (380 \text{ VDC}) = 17.4 \text{ A}$$

- To determine the required BTUs, multiply the Watts that is required for the power source by 3.41214163.

For example, for 6593 W, use the following formula:

$$(6593 \text{ W}) \times (3.41214163 \text{ BTU}) = 22,496$$

To size the circuit breaker for the required amperage, you must also divide the required amperage by the percentage. For example, if the switch requires an input amperage of 33 A and you are able to use up to 80 percent of the capacity of a circuit breaker, you use the following formula to calculate the minimum amperage that is required of the circuit breaker:

$$(33 \text{ A}) / (80\% \text{ or } 0.80) = 41.25 \text{ amps}$$

Step 4 Select one of the following power modes to determine the number of additional power supplies required for reserve power:

Configured Power Redundancy Mode	Power Supply	Instructions and Guidelines	Input Source or Grid Redundancy	n+n Power Supply Redundancy	n+1 Power Supply Redundancy
n+1 redundancy	N9K-PUV2-3000W-B	<p>Instructions:</p> <p>Add at least 1 more power supply to the number of power supplies determined in step 2.</p> <p>Connect one input to one power source (A) and the other input to another power source (B).</p> <p>Guidelines:</p> <p>Recommended if the number of power supplies from step 2 is 5 or higher.</p>	Yes	No	Yes
combined	N9K-PUV2-3000W-B	<p>Instructions:</p> <p>Install the number of power supplies as determined in step 2.</p> <p>Connect one input to one power source (A) and the other input to another power source (B).</p> <p>Guidelines:</p> <p>Recommended if the number of power supplies from step 2 is 5 or higher.</p>	Yes	No	No

Configured Power Redundancy Mode	Power Supply	Instructions and Guidelines	Input Source or Grid Redundancy	<i>n+n</i> Power Supply Redundancy	<i>n+1</i> Power Supply Redundancy
<i>n+n</i> redundancy	N9K-PAC-3000W-B	Instructions:	Yes	Yes	Yes
	N9K-PDC-3000W-B	Add twice the number of power supplies as determined in step 2.			
	N9K-PUV-3000W-B	Connect one half of the power supplies to one power source (A) and connect another half of the power supplies to another power source (B).			
	N9K-PUV2-3000W-B	Guidelines: Recommended if the number of power supplies from step 2 is 4 or less.			
<i>n+n</i> redundancy	N9K-PAC-3000W-B	Instructions:	No	Yes	Yes
	N9K-PDC-3000W-B	Add twice the number of power supplies as determined in step 2.			
	N9K-PUV-3000W-B	Guidelines:			
	N9K-PUV2-3000W-B	Recommended if the number of power supplies from step 2 is 4 or less.			
<i>n+1</i> redundancy	N9K-PAC-3000W-B	Instructions:	No	No	Yes
	N9K-PDC-3000W-B	Add at least 1 more power supply to the number of power supplies determined in step 2.			
	N9K-PUV-3000W-B	Guidelines:			
	N9K-PUV2-3000W-B	Recommended if the number of power supplies from step 2 is 1 or higher.			
combined	N9K-PAC-3000W-B	Instructions:	No	No	No
	N9K-PDC-3000W-B	Install the number of power supplies as determined in step 2.			
	N9K-PUV-3000W-B	Guidelines:			
	N9K-PUV2-3000W-B	Recommended if the number of power supplies from step 2 is 1 or higher.			

Step 5 Be sure that the power source circuits are dedicated to the switch and not to other electrical equipment.

For combined mode or *n+1* redundancy mode, you need only one dedicated circuit. For *n+n* redundancy, you must have two dedicated power circuits, with each circuit powering half of the 3-kW power supplies. The requirements for each circuit are listed in the following table.

Power Supply	Number of Circuits	Requirement for Each Circuit
3-kW AC power supply (N9K-PAC-3000W-B)	1 (combined mode or <i>n+1</i> redundancy mode)	16 A at 200 to 240 VAC
	2 (<i>n+n</i> redundancy mode)	

Power Supply	Number of Circuits	Requirement for Each Circuit
3-kW Universal AC/DC power supply (N9K-PUV-3000W-B and N9K-PUV2-3000W-B)	1 (combined mode or $n+1$ redundancy mode) 2 ($n+n$ redundancy mode)	AC power: 200 to 277 VAC DC power: 240 to 380 VDC
3-kW DC power supply (N9K-PDC-3000W-B)	1 (combined mode or $n+1$ redundancy mode) 2 ($n+n$ redundancy mode)	45A at -40 to -75 VDC (-48 VDC nominal US) (-60 VDC nominal international)

Step 6 Plan the placement of the input power receptacles within reach of the power cables that are used for each power supply, see the following table for the maximum distances.

Typically, power receptacles are placed on the rack with the switch.

Power Supply	Maximum Distance Between Receptacle and Power Supply
3-kW AC power supplies	8 to 12 feet (2.5 to 3.5 m)
3-kW Universal AC/DC power supplies	14 feet (4.27 m)
3-kW DC power supplies	You provide four 6-gauge wires (recommended) and cuts that wire to the required length. We provide four 6-gauge lugs to connect those wires to the DC power supply.

Note The switch can be powered by a mix of AC, DC, HVAC/HVDC power sources.

Airflow Requirements

The switch is positioned with its ports in either the front or the rear of the rack depending on your cabling and maintenance requirements.

To identify the airflow options for your switch, see the user-replaceable components in the *Overview* section of this document.

You must have fan and power supply modules that move the coolant air from the cold aisle to the hot aisle in one of the following ways:

- Port-side exhaust airflow—Cool air enters the chassis through the fan and power supply modules in the cold aisle and exhausts through the port end of the chassis in the hot aisle.
- Port-side intake airflow—Cool air enters the chassis through the port end in the cold aisle and exhausts through the fan and power supply modules in the hot aisle.

You can identify the airflow direction of each fan and power supply module by its coloring as follows:

- Blue coloring indicates port-side exhaust airflow.

- Burgundy coloring indicates port-side intake airflow.



Note To prevent the switch from overheating and shutting down, you must position the air intake for the switch in a cold aisle. The fan and power supply modules must have the same direction of airflow. If you must change the airflow direction for the switch, you must shutdown the switch before changing the modules.

Rack and Cabinet Requirements

You can install the following types of racks or cabinets for your switch:

- Standard perforated cabinets
- Solid-walled cabinets with a roof fan tray (bottom-to-top cooling)
- Standard open four-post Telco racks

To install the switch in a cabinet that is located in a hot-aisle and cold-aisle environment, fit the cabinet with baffles to prevent exhaust air from recirculating into the chassis air intake.

Work with your cabinet vendors to determine which of their cabinets meet the following requirements or see the Cisco Technical Assistance Center (TAC) for recommendations:

- Use a standard 19-inch (48.3-cm), four-post Electronic Industries Alliance (EIA) cabinet or rack with mounting rails that conform to English universal hole spacing per section 1 of the ANSI/EIA-310-D-1992 standard.
- The height of the rack or cabinet must accommodate the 13-RU (22.7 inches or 57.8 cm) height of the switch and its bottom support bracket.
- The depth of a four-post rack must be 24 to 32 inches (61.0 to 81.3 cm) between the front and rear mounting rails (for proper mounting of the bottom-support brackets or other mounting hardware).
- Required clearances between the chassis and the edges of its rack or the interior of its cabinet are as follows:
 - 4.5 inches (11.4 cm) between the front of the chassis and the front of the rack or interior of the cabinet (required for cabling and module handles).
 - 3.0 inches (7.6 cm) between the rear of the chassis and the interior of the cabinet (required for airflow in the cabinet if used).
 - No clearance is required between the chassis and the sides of the rack or cabinet (no side airflow).

Also, you must consider the following site requirements for the rack:

- Power receptacles must be located within reach of the power cords that are used with the switch.
 - Power cords for the 3-kW AC power supplies are 8 to 12 feet (2.5 to 4.3 m) long.
 - Power cords for the 3-kW Universal AC power supplies are 14 feet (4.27 m) long.



Note The power cables for the 3-kW DC power supply are provided by and sized you.

- Clearance is required for cables that connect to as many as 288 ports (in addition to the cabling required for other devices in the same rack). These cables must not block access to any removable chassis modules or block airflow into or out of the chassis. Route the cables through the cable management frames on the left and right sides of the chassis.

Also, you must have power receptacles that are located within reach of the power cords that are used with the switch.

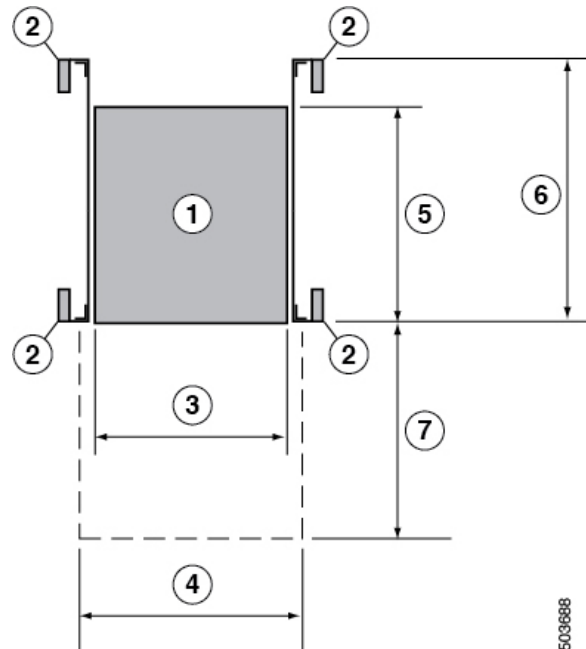


Warning Statement 1048—Rack Stabilization

The rack stabilizing mechanism must be in place, or the rack must be bolted to the floor before installation or servicing. Failure to stabilize the rack can cause bodily injury.

Clearance Requirements

Provide the chassis with adequate clearance between the chassis and any other rack, device, or structure so that you can properly install the chassis. Provide the chassis with adequate clearance to route cables, provide airflow, and maintain the switch. For the clearances required for an installation of this chassis in a four-post rack, see the following figure.



503688

1	Chassis	5	Depth of the chassis 25.48 in (64.72 cm)
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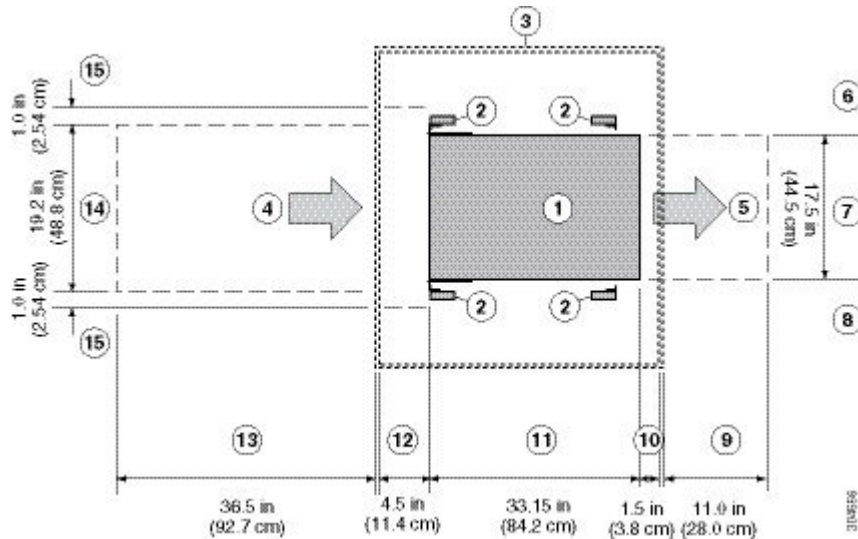
2	Vertical rack-mount posts and rails	6	Maximum extension of the bottom-support rails 36.0 in (91.0 cm)
3	Chassis width 17.3 in (43.9 cm)	7	Depth of the front clearance area (equal to the depth of the chassis). 25.48 in (64.72 cm)
4	Width of the front clearance area (equal to the width of the chassis with two rack-mount brackets that are attached to it). 19.0 in (48.3 cm)		



Note Both the front and rear of the chassis must be open to both aisles for airflow.

Clearance Requirements

Provide the chassis with adequate clearance between the chassis and any other rack, device, or structure so that you can properly install the chassis. Provide the chassis with adequate clearance to route cables, provide airflow, and maintain the switch. For the clearances required for an installation of this chassis, see the following figure.



1	Chassis	9	Rear service clearance required to replace fan trays and fabric modules.
2	Vertical rack-mount posts and rails	10	Minimum clearance required for module handles (up to 6 inches [15.24 cm] recommended for optimal airflow) when using cabinet doors
3	Cabinet (optional)	11	Chassis depth

4	Air intake from the cold aisle for all modules and power supplies	12	Recommended clearance for cable management and ejector handles on line cards (6 inches [15.24 cm] recommended for optimal airflow) when using cabinet doors
5	Air exhaust to the hot aisle for all modules and power supplies	13	Clearance required for installing the chassis and replacing line cards
6	No left-side clearance required (no airflow on the left side).	14	Width of the chassis plus vertical mounting brackets on each side
7	Chassis width	15	Side clearance, that is required for older line card handle rotation (not required for the current line cards which have handles that rotate differently).
8	No right-side clearance required (no airflow on the right side).		

